XXXIII. *Account of ſome Obſervations tending to inveſtigate the Conſtruction of the Heavens. By* William Herſchel, *Eſq. F. R. S.*

Read June 17, 1784.

IN a former paper I mentioned, that a more powerful inſtrument was preparing for continuing my reviews of the heavens. The teleſcope I have lately completed, though far inferior in ſize to the one I had undertaken to conſtruct when that paper was written, is of the Newtonian form, the object ſpeculum being of 20 feet focal length, and its aperture 18$\frac{7}{10}$ inches. The apparatus on which it is mounted is contrived ſo as at preſent to confine the inſtrument to a meridional ſituation, and by its motions to give the right-aſcenſion and declination of a celeſtial object in a coarſe way; which, however, is ſufficiently accurate to point out the place of the object, ſo that it may be found again. It will not be neceſſary to enter into a more particular deſcription of the apparatus, ſince the account I have now the honour of communicating to the Royal Society regards rather the performance of the teleſcope than its conſtruction.

It would, perhaps, have been more eligible to have waited longer, in order to complete the diſcoveries that ſeem to lie within the reach of this inſtrument, and are already, in ſome reſpects, pointed out to me by it. By taking more time I ſhould undoubtedly be enabled to ſpeak more confidently of the *interior conſtruction* of the heavens, and its various ***nebulous and*** *ſidereal ſtrata* (to borrow a term from the natural hiſtorian) of which this paper can as yet only give a few outlines, or rather hints. As an apology, however, for this prematurity, it may be ſaid, that the end of all diſcoveries being communication, we can never be too ready in giving facts and obſervations, whatever we may be in reaſoning upon them.

Hitherto the ſidereal heavens have, not inadequately for the purpoſe deſigned, been repreſented by the concave ſurface of a ſphere, in the center of which the eye of an obſerver might be ſuppoſed to be placed. It is true, the various magnitudes of the fixed ſtars even then plainly ſuggeſted to us, and would have better ſuited the idea of an expanded firmament of three dimenſions; but the obſervations upon which I am now going to enter ſtill farther illuſtrate and enforce the neceſſity of conſidering the heavens in this point of view. In future, therefore, we ſhall look upon thoſe regions into which we may now penetrate by means of ſuch large teleſcopes, as a naturaliſt regards a rich extent of ground or chain of mountains, containing ſtrata variouſly inclined and directed, as well as conſiſting of very different materials. A ſurface of a globe or map, therefore, will but ill delineate the interior parts of the heavens.

It may well be expected, that the great advantage of a large aperture would be moſt ſenſibly perceived with all thoſe objects that require much light, ſuch as the very ſmall and immenſely diſtant fixed ſtars, the very faint nebulæ, the cloſe and compreſſed cluſters of ſtars, and the remote planets.

On applying the teleſcope to a part of the *via lactea*, I found that it completely reſolved the whole whitiſh appearance into ſmall ſtars, which my former teleſcopes had not light enough to effect. The portion of this extenſive tract, which it has hitherto been convenient for me to obſerve, is that immediately about the hand and club of Orion. The glorious multitude of ſtars of all poſſible ſizes that preſented themſelves here to my view was truly aſtoniſhing; but, as the dazzling brightneſs of glittering ſtars may eaſily miſlead us ſo far as to eſtimate their number greater than it really is, I endeavoured to aſcertain this point by counting many fields, and computing, from a mean of them, what a certain given portion of the milky way might contain. Among many trials of this ſort I found, laſt January the 18th, that ſix fields, promiſcuouſly taken, contained 110, 60, 70, 90, 70, and 74 ſtars each. I then tried to pick out the moſt vacant place that was to be found in that neighbourhood, and counted 63 ſtars. A mean of the firſt ſix gives 79 ſtars for each field. Hence, by allowing 15 minutes of a great circle for the diameter of my field of view, we gather, that a belt of 15 degrees long and two broad, or the quantity which I have often ſeen paſs through the field of my teleſcope in one hour's time, could not well contain leſs than fifty thouſand ſtars, that were large enough to be diſtinctly numbered. But, beſides theſe, I ſuſpected at leaſt twice as many more, which, for want of light, I could only ſee now and then by faint glittering and interrupted glimpſes.

The excellent collection of nebulæ and cluſters of ſtars which has lately been given in the *Connoiſſance des Temps* for 1783 and 1784, leads me next to a ſubject which, indeed, muſt open a new view of the heavens. As ſoon as the firſt of theſe volumes came to my hands, I applied my former 20-feet reflector of 12 inches aperture to them; and ſaw, with the greateſt pleaſure, that moſt of the nebulæ, which I had an opportunity of examining in proper ſituations, yielded to the force of my light and power, and were reſolved into ſtars. For inſtance, the 2d, 5, 9, 10, 12, 13, 14, 15, 16, 19, 22, 24, 28, 30, 31, 37, 51, 52, 53, 55, 56, 62, 65, 66, 67, 71, 72, 74, 92, all which are ſaid to be nebulæ without ſtars, have either plainly appeared to be nothing but ſtars, or at leaſt to contain ſtars, and to ſhew every other indication of conſiſting of them entirely. I have examined them with a careful ſcrutiny of various powers and light, and generally in the meridian. I ſhould mention, that five of the above, *viz.* the 16th, 24, 37, 52, 67, are called cluſters of ſtars containing nebuloſity; but my inſtrument reſolving alſo that portion of them which is called nebulous into ſtars of a much ſmaller ſize, I have placed them into the above number. To theſe may be added the 1ſt, 3d, 27, 33, 57, 79, 81, 82, 101, which in my 7, 10, and 20-feet reflectors ſhewed a mottled kind of nebuloſity, which I ſhall call reſolvable; ſo that I expect my preſent teleſcope will, perhaps, render the ſtars viſible of which I ſuppoſe them to be compoſed. Here I might point out many precautions neceſſary to be taken with the very beſt inſtruments, in order to ſucceed in the reſolution of the moſt difficult of them; but reſerving this at preſent too extenſive ſubject for a future opportunity, I proceed to ſpeak of the effects of my laſt inſtrument with regard to nebulæ.

My preſent purſuits, as I obſerved before, requiring this teleſcope to act as a fixed inſtrument, I found it not convenient to apply it to any other of the nebulæ in the *Connoiſſance des Temps* but ſuch as came in turn; nor, indeed, was it neceſſary to take any particular pains to look for them, it being utterly impoſſible that any one of them ſhould eſcape my obſervation when it paſſed the field of view of my teleſcope. The few which I have already had an opportunity of examining, ſhew plainly that thoſe moſt excellent French aſtronomers, Meſſ. MESSIER and MECHAIN, ſaw only the more luminous part of their nebulæ; the feeble ſhape of the remainder, for want of light, eſcaping their notice. The difference will appear when we compare my obſervation of the 98th nebula with that in the *Connoiſſance des Temps* for 1784, which runs thus: "Nébuleuſe ſans étoile, "d'une lumière extrêmement foible, au deſſus de l'aile boréale "de la Vierge, ſur le parallèle et près de l'étoile N° 6. cinquième grandeur, de la chevelure de Bérénice, ſuivant "FLAMSTEED. M. MECHAIN la vit le 15 Mars, 1781." My obſervation of the 30th of December, 1783, is thus: A large, extended, fine nebula. Its ſituation ſhews it to be M. MESSIER's 98th; but from the deſcription it appears, that that gentleman has not ſeen the whole of it, for its feeble branches extend above a quarter of a degree, of which no notice is taken. Near the middle of it are a few ſtars viſible, and more ſuſpected My field of view will not quite take in the whole nebula. See fig. 1. tab. XVII. Again, N° 53. "Nébuleuſe ſans étoiles, "decouverte au-deſſous et près de la chevelure de Bérénice, à "peu de diſtance de l'étoile quarante-deuxieme de cette conſtel-"lation, ſuivant FLAMSTEED. Cette nébuleuſe eſt ronde et "apparente, &c." My obſervation of the 170th Sweep runs thus: A cluſter of very cloſe ſtars; one of the moſt beautiful objects I remember to have ſeen in the heavens. The cluſter appears under the form of a ſolid ball, conſiſting of ſmall ſtars, quite compreſſed into one blaze of light, with a great number of looſe ones ſurrounding it, and diſtinctly viſible in the general maſs. See fig. 2.

When I began my preſent ſeries of obſervations, I ſurmiſed, that ſeveral nebulæ might yet remain undiſcovered, for want of ſufficient light to detect them; and was, therefore, in hopes of making a valuable addition to the cluſters of ſtars and nebulæ already collected and given us in the work before referred to, which amount to 103. The event has plainly proved that my expectations were well founded: for I have already found 466 new nebulæ and cluſters of ſtars, none of which, to my preſent knowledge, have been ſeen before by any perſon; moſt of them, indeed, are not within the reach of the beſt common teleſcopes now in uſe. In all probability many more are ſtill in reſerve; and as I am purſuing this track, I ſhall make them up into ſeparate catalogues, of about two or three hundred at a time, and have the honour of preſenting them in that form to the Royal Society.

A very remarkable circumſtance attending the nebulæ and cluſters of ſtars is, that they are arranged into ſtrata, which ſeem to run on to a great length; and ſome of them I have already been able to purſue, ſo as to gueſs pretty well at their form and direction. It is probable enough, that they may ſurround the whole apparent ſphere of the heavens, not unlike the milky way, which undoubtedly is nothing but a ſtratum of fixed ſtars. And as this latter immenſe ſtarry bed is not of equal breadth or luſtre in every part, nor runs on in one ſtraight direction, but is curved and even divided into two ſtreams along a very conſiderable portion of it; we may likewiſe expect the greateſt variety in the ſtrata of the cluſters of ſtars and nebulæ. One of theſe nebulous beds is ſo rich, that, in paſſing through a ſection of it, in the time of only 36 minutes, I detected no leſs than 31 nebulæ, all diſtinctly viſible upon a fine blue ſky. Their ſituation and ſhape, as well as condition, ſeems to denote the greateſt variety imaginable. In another ſtratum, or perhaps a different branch of the former, I have ſeen double and treble nebulæ, variouſly arranged; large ones with

with ſmall, ſeeming attendants; narrow but much extended, lucid nebulæ or bright daſhes; ſome of the ſhape of a fan, reſembling an electric bruſh, iſſuing from a lucid point; others of the cometic ſhape, with a ſeeming nucleus in the center; or like cloudy ſtars, ſurrounded with a nebulous atmoſphere; a different ſort again contain a nebuloſity of the milky kind, like that wonderful, inexplicable phænomenon about θ Orionis; while others ſhine with a fainter, mottled kind of light, which denotes their being reſolvable into ſtars. See fig. 3. &c. But it would be too extenſive at preſent to enter more minutely into ſuch circumſtances, therefore I proceed with the ſubject of nebulous and ſidereal ſtrata.

It is very probable, that the great ſtratum, called the milky way, is that in which the ſun is placed, though perhaps not in the very center of its thickneſs. We gather this from the appearance of the Galaxy, which ſeems to encompaſs the whole heavens, as it certainly muſt do if the ſun is within the ſame. For, ſuppoſe a number of ſtars arranged between two parallel planes, indefinitely extended every way, but at a given conſiderable diſtance from each other; and, calling this a ſidereal ſtratum, an eye placed ſomewhere within it will ſee all the ſtars in the direction of the planes of the ſtratum projected into a great circle, which will appear lucid on account of the accumulation of the ſtars; while the reſt of the heavens, at the ſides, will only ſeem to be ſcattered over with conſtellations, more or leſs crowded, according to the diſtance of the planes or number of ſtars contained in the thickneſs or ſides of the ſtratum.

Thus, in fig. 16. (tab. XVIII.) an eye at S within the ſtratum *a b*, will ſee the ſtars in the direction of its length *a b*, or height *c d*, with all thoſe in the intermediate ſituations, projected into the lucid circle ACBD; while thoſe in the ſides *mv*, *nw*, will be ſeen ſcattered over the remaining part of the heavens at MVNW.

If the eye were placed ſomewhere without the ſtratum, at no very great diſtance, the appearance of the ſtars within it would aſſume the form of one of the leſs circles of the ſphere, which would be more or leſs contracted to the diſtance of the eye; and if this diſtance were exceedingly increaſed, the whole ſtratum might at laſt be drawn together into a lucid ſpot of any ſhape, according to the poſition, length, and height of the ſtratum.

Let us now ſuppoſe, that a branch, or ſmaller ſtratum, ſhould run out from the former, in a certain direction, and let it alſo be contained between two parallel planes extended indefinitely onwards, but ſo that the eye may be placed in the great ſtratum ſomewhere before the ſeparation, and not far from the place where the ſtrata are ſtill united. Then will this ſecond ſtratum not be projected into a bright circle like the former, but will be ſeen as a lucid branch proceeding from the firſt, and returning to it again at a certain diſtance leſs than a ſemi-circle.

Thus, in the ſame figure, the ſtars in the ſmall ſtratum *pq* will be projected into a bright arch at PRRP, which, after its ſeparation from the circle CBD, unites with it again at P.

What has been inſtanced in parallel planes may eaſily be applied to ſtrata irregularly bounded, and running in various directions; for their projections will of conſequence vary according to the quantities of the variations in the ſtrata and the diſtance of the eye from the ſame. And thus any kind of curvatures, as well as various different degrees of brightneſs, may be produced in the projections.

From

From appearances then, as I obſerved before, we may infer, that the ſun is moſt likely placed in one of the great ſtrata of the fixed ſtars, and very probably not far from the place where ſome ſmaller ſtratum branches out from it. Such a ſuppoſition will ſatisfactorily, and with great ſimplicity, account for all the phænomena of the milky way, which, according to this hypotheſis, is no other than the appearance of the projection of the ſtars contained in this ſtratum and its ſecondary branch. As a farther inducement to look on the Galaxy in this point of view, let it be conſidered, that we can no longer doubt of its whitiſh appearance ariſing from the mixed luſtre of the numberleſs ſtars that compoſe it. Now, ſhould we imagine it to be an irregular ring of ſtars, in the center nearly of which we muſt then ſuppoſe the ſun to be placed, it will appear not a little extraordinary, that the ſun, being a fixed ſtar like thoſe which compoſe this imagined ring, ſhould juſt be in the center of ſuch a multitude of celeſtial bodies, without any apparent reaſon for this ſingular diſtinction; whereas, on our ſuppoſition, every ſtar in this ſtratum, not very near the termination of its length or height, will be ſo placed as alſo to have its own Galaxy, with only ſuch variations in the form and luſtre of it, as may ariſe from the particular ſituation of each ſtar.

Various methods may be purſued to come to a full knowledge of the ſun's place in the ſidereal ſtratum, of which I ſhall only mention one as the moſt general and moſt proper for determining this important point, and which I have already begun to put in practice. I call it *Gaging the Heavens*, or the *Star-Gage*. It conſiſts in repeatedly taking the number of ſtars in ten fields of view of my reflector very near each other, and by adding their ſums, and cutting off one decimal on the right, a mean of the contents of the heavens, in all the parts which are thus gaged, is obtained. By way of example, I have joined a ſhort table, extracted from the gages contained in my journal, by which it appears, that the number of ſtars increaſes very faſt as we approach the Via Lactea.

N. P. D. 92 to 94°.	
R. A.	Gage.
15 10	9.4
15 22	10.6
15 47	10.6
16 8	12.1
16 25	13.6
16 37	18.6

N. P. D. 78 to 80°.	
R. A.	Gage.
11 16	3.1
12 31	3.4
12 44	4.6
12 49	3.9
13 5	3.8
14 30	3.6

Thus, in the parallel from 92 to 94 degrees north polar diſtance, and R. A. 15 h. 10′, the ſtar-gage runs up from 9.4 ſtars in the field to 18.6 in about an hour and a half; whereas in the parallel from 78° to 80° north polar diſtance, and R. A. 11, 12, 13, and 14 hours, it very ſeldom riſes above 4. We are, however, to remember, that with different inſtruments the account of the gages will be very different, eſpecially on our ſuppoſition of the ſituation of the ſun in a ſtratum of ſtars. For, let *a b*, fig. 17. be the ſtratum, and ſuppoſe the ſmall circle *g h l k* to repreſent the ſpace into which, by the light and power of a given teleſcope, we may penetrate; and let GHLK be the extent of another portion, which we are enabled to viſit by means of a larger aperture and power; it is evident, that the gages with the latter inſtrument will differ very much in their account of ſtars contained at MN, and at KG or LH; when with the former they will hardly be affected by the change from *m n* to *k g* or *l h*. And this accounts for what a celebrated author ſays concerning the effects of teleſcopes,

ſcopes, by which we muſt underſtand the beſt of thoſe that are in common uſe *.

It would not be ſafe to enter into an application of theſe, and ſuch other gages as I have already taken, till they are ſufficiently continued and carried all over the heavens. I ſhall, therefore, content myſelf with juſt mentioning that the ſituation of the ſun will be obtained, from conſidering in what manner the ſtar-gage agrees with the length of a ray revolving in ſeveral directions about an aſſumed point, and cut off by the bounds of the ſtratum. Thus, in fig. 18. let S be the place of an obſerver; S r r r, S *r r r*, lines in the planes r S r, *r* S *r*, drawn from S within the ſtratum to one of the boundaries, here repreſented by the plane AB. Then, ſince neither the ſituation of S, nor the form of the limiting ſurface AB, is given, we are to aſſume a point, and apply to it lines proportional to the ſeveral gages that have been obtained, and at ſuch angles from each other as they may point out; then will the termination of theſe lines delineate the boundary of the ſtratum, and conſequently manifeſt the ſituation of the ſun within the ſame. But to proceed.

If the ſun ſhould be placed in the great ſidereal ſtratum of the milky way, and, as we have ſurmiſed above, not far from the branching out of a ſecondary ſtratum, it will very naturally lead us to gueſs at the cauſe of the probable motion of the ſolar ſyſtem: for the very bright, great node of the Via Lactis, or union of the two ſtrata about Cepheus and Caſſiopeia, and the Scorpion and Sagittarius, points out a conflux of ſtars manifeſtly quite ſufficient to occaſion a tendency towards that node in any ſtar ſituated at no very great diſtance; and the ſecondary branch of the Galaxy not being much leſs than a ſemi-circle ſeems to indicate ſuch a ſituation of our ſolar ſyſtem in the great undivided ſtratum as the moſt probable.

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* On voit avec les téleſcopes des étoiles dans toutes les parties du ciel, à peu près comme dans la voie lactée, ou dans les nébuleuſes. On ne ſauroit douter qu'une partie de l'éclat et de la blancheur de la voie lactée, ne provienne de la lumière des petites étoiles qui s'y trouvent en effet par millions; cependant, avec les plus grands téleſcopes, on n'en diſtingue pas aſſés, et elles n'y ſont pas aſſés rapprochées les unes des autres pour qu'on puiſſe attribuer à celles qu'on diſtingue la blancheur de la voie lactée, ſi ſenſible à la vue ſimple. L'on ne ſauroit donc prononcer que les étoiles ſoient la ſeule cauſe de cette blancheur, quoique nous ne connoiſſions aucune maniére ſatisfaiſante de l'expliquer. Aſt. M. De la Lande, § 833.

What has been ſaid in a former paper on the ſubject of the ſolar motion ſeems alſo to ſupport this ſuppoſed ſituation of the ſun; for the apex there aſſigned lies nearly in the direction of a motion of the ſun towards the node of the ſtrata. Beſides, the joining ſtratum making a pretty large angle at the junction with the primary one, it may eaſily be admitted, that the motion of a ſtar in the great ſtratum, eſpecially if ſituated conſiderably towards the ſide fartheſt from the ſmall ſtratum, will be turned ſufficiently out of the ſtraight direction of the great ſtratum towards the ſecondary one. But I find myſelf inſenſibly led to ſay more on this ſubject than I am as yet authoriſed to do; I will, therefore, return to thoſe obſervations which have ſuggeſted the idea of celeſtial ſtrata.

In my late obſervations on nebulæ I ſoon found, that I generally detected them in certain directions rather than in others; that the ſpaces preceding them were generally quite deprived of their ſtars, ſo as often to afford many fields without a ſingle ſtar in it; that the nebulæ generally appeared ſome time after among ſtars of a certain conſiderable ſize, and but ſeldom among very ſmall ſtars; that when I came to one nebula, I generally found ſeveral more in the neighbourhood; that afterwards

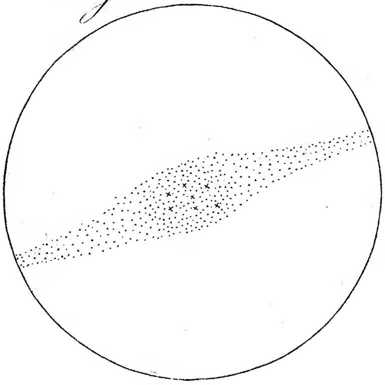
wards a conſiderable time paſſed before I came to another parcel; and theſe events being often repeated in different altitudes of my inſtrument, and ſome of them at a conſiderable diſtance from each other, it occurred to me, that the intermediate ſpaces between the ſweeps might alſo contain nebulæ; and finding this to hold good more than once, I ventured to give notice to my aſſiſtant at the clock, "to prepare, ſince I ex-" pected in a few minutes to come at a ſtratum of the nebulæ, " finding myſelf already" (as I then figuratively expreſſed it) " on nebulous ground." In this I ſucceeded immediately; ſo that I now can venture to point out ſeveral not far diſtant places, where I ſhall ſoon carry my teleſcope, in expectation of meeting with many nebulæ. But how far theſe circumſtances of vacant places preceding and following the nebulous ſtrata, and their being as it were contained in a bed of ſtars, ſparingly ſcattered between them, may hold good in more diſtant portions of the heavens, and which I have not yet been able to viſit in any regular manner, I ought by no means to hazard a conjecture. The ſubject is new, and we muſt attend to obſervations, and be guided by them, before we form general opinions.

Before I conclude, I may, however, venture to add a few particulars about the direction of ſome of the capital ſtrata or their branches. The well known nebula of Cancer, viſible to the naked eye, is probably one belonging to a certain ſtratum, in which I ſuppoſe it to be ſo placed as to lie neareſt to us. This ſtratum I ſhall call that of Cancer. It runs from ε Cancri towards the ſouth over the 67 nebula of the *Connoiſſance des Temps*, which is a very beautiful and pretty much compreſſed cluſter of ſtars, eaſily to be ſeen by any good teleſcope, and in which I have obſerved above 200 ſtars at once in the field of view.

view of my great reflector, with a power of 157. This cluſter appearing ſo plainly with any good, common teleſcope, and being ſo near to the one which may be ſeen by the naked eye, denotes it to be probably the next in diſtance to that within the quartile formed by γ, δ, η, θ; from the 67th nebula the ſtratum of Cancer proceeds towards the head of Hydra; but I have not yet had time to trace it farther than the equator.

Another ſtratum, which perhaps approaches nearer to the ſolar ſyſtem than any of the reſt, and whoſe ſituation is nearly at rectangles to the great ſidereal ſtratum in which the ſun is placed, is that of Coma Berenices, as I ſhall call it. I ſuppoſe the Coma itſelf to be one of the cluſters in it, and that, on account of its nearneſs, it appears to be ſo ſcattered. It has many capital nebulæ very near it; and in all probability this ſtratum runs on a very conſiderable way. It may, perhaps, even make the circuit of the heavens, though very likely not in one of the great circles of the ſphere: for, unleſs it ſhould chance to interſect the great ſidereal ſtratum of the milky way before-mentioned, in the very place in which the ſun is ſtationed, ſuch an appearance could hardly be produced. However, if the ſtratum of Coma Berenices ſhould extend ſo far as (by taking in the aſſiſtance of M. MESSIER's and M. MECHAIN's excellent obſervations of ſcattered nebulæ, and ſome detached former obſervations of my own) I apprehend it may, the direction of it towards the north lies probably, with ſome windings, through the great Bear onwards to Caſſiopeia; thence through the girdle of Andromeda and the northern Fiſh, proceeding towards Cetus; while towards the ſouth it paſſes through the Virgin, probably on to the tail of Hydra and the head of Centaurus. But, notwithſtanding I have already fully aſcertained the exiſtence and direction of this ſtratum for more

Fig. 1.



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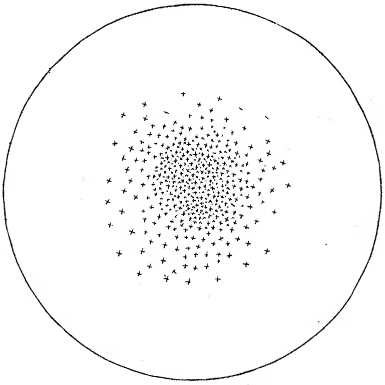

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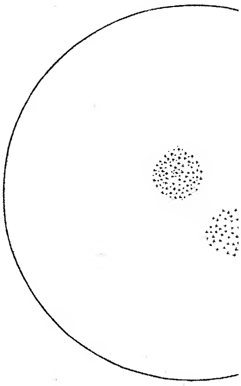

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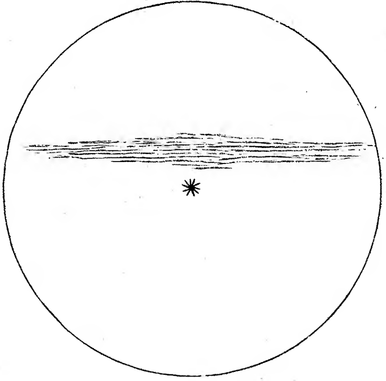

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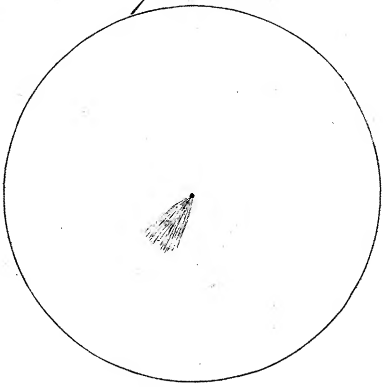

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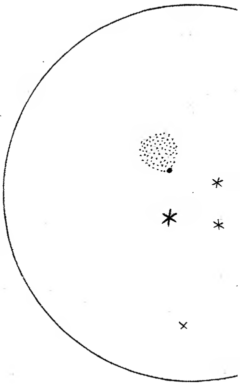

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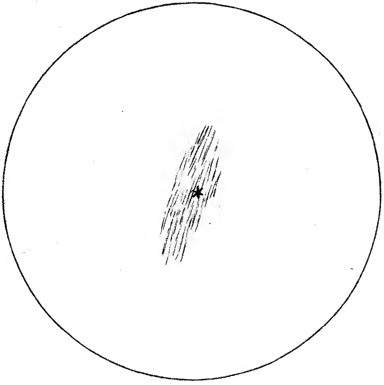

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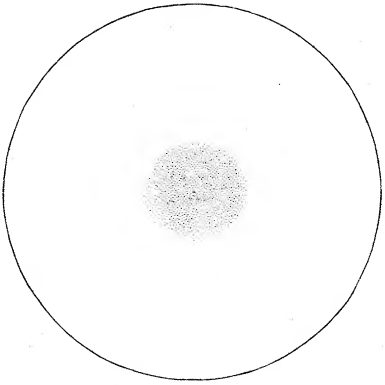

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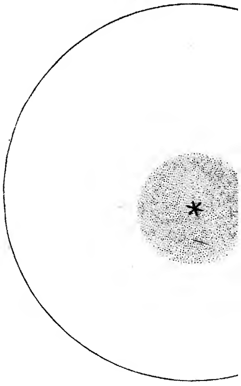

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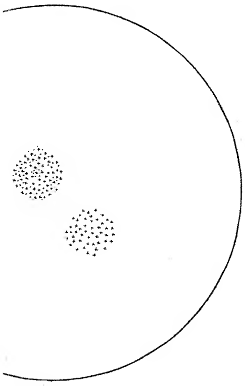

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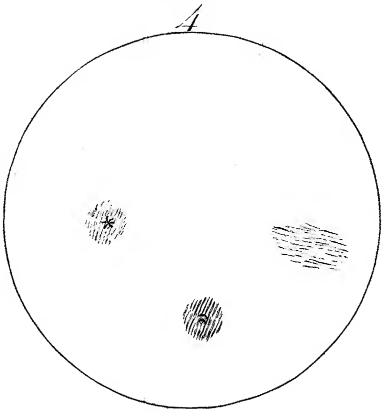

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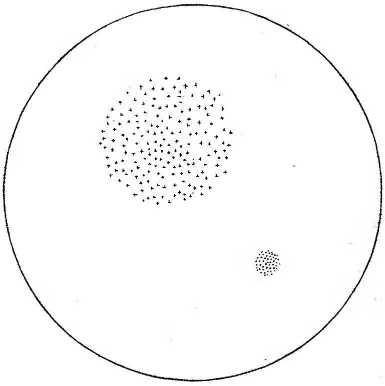

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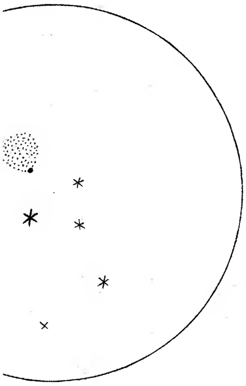

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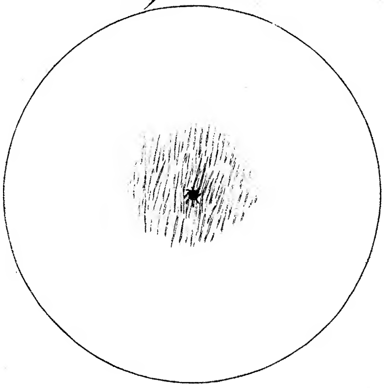

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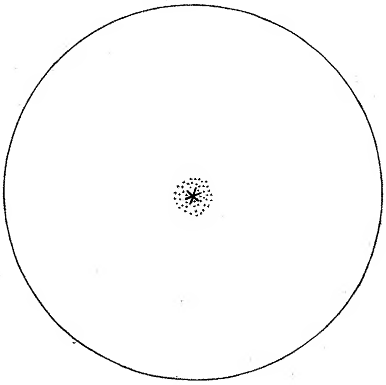

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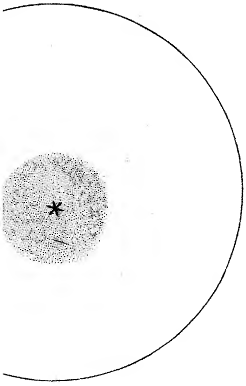

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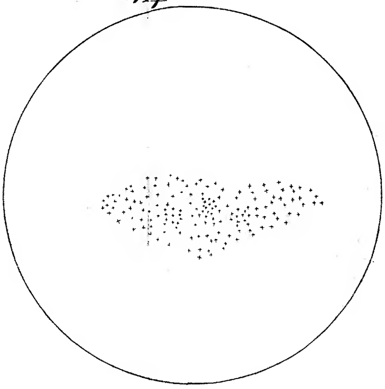

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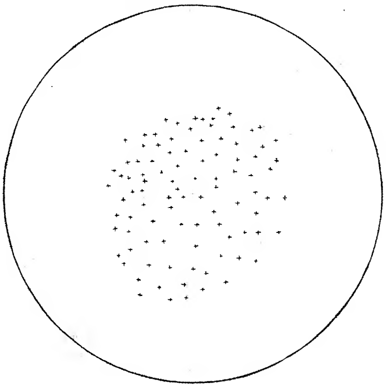

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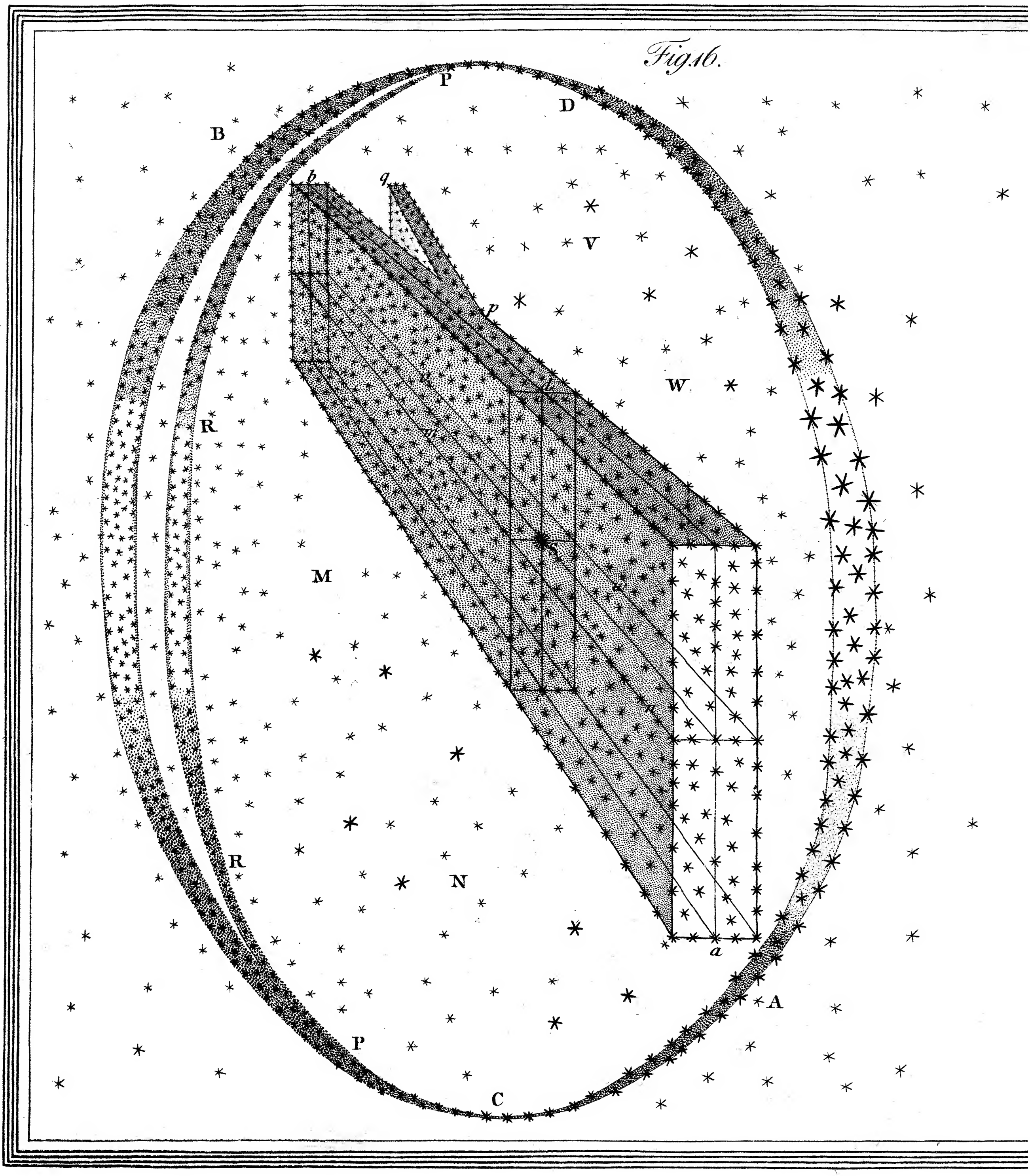
Fig. 16.



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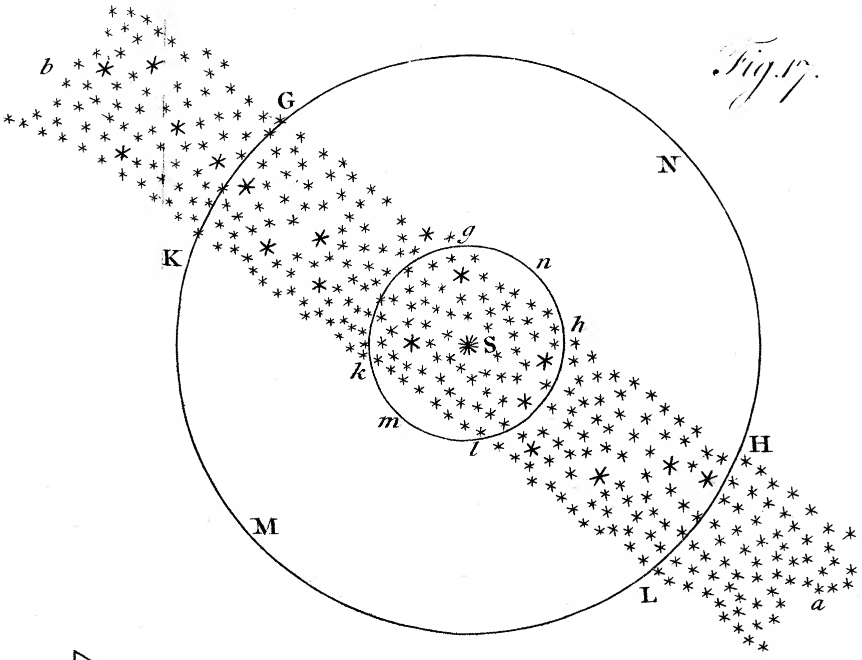

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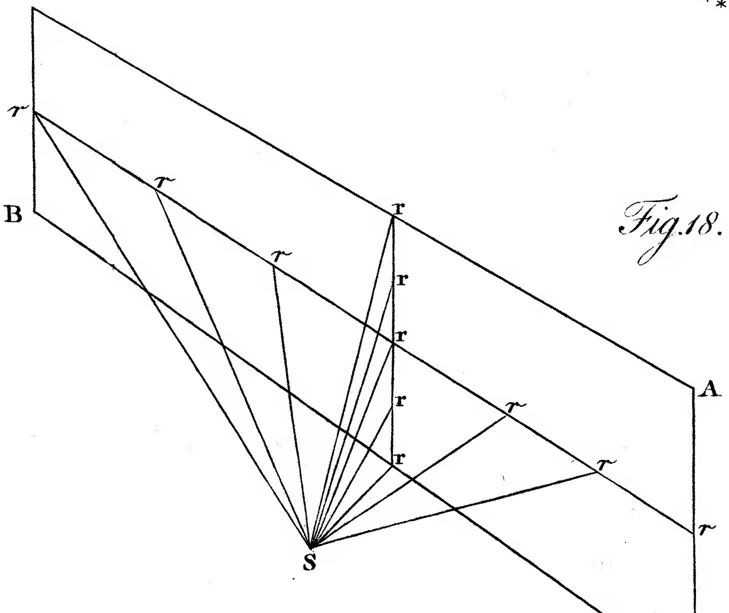

Fig. 18.

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than 30 degrees of a great circle, and found it almoſt every where equally rich in fine nebulæ, it ſtill might be dangerous to proceed in more extenſive conjectures, that have as yet no more than a precarious foundation. I ſhall therefore wait till the obſervations in which I am at preſent engaged ſhall furniſh me with proper materials for the diſquiſition of ſo new a ſubject. And though my ſingle endeavours ſhould not ſucceed in a work that ſeems to require the joint effort of every aſtronomer, yet ſo much we may venture to hope, that, by applying ourſelves with all our powers to the improvement of teleſcopes, which I look upon as yet in their infant ſtate, and turning them with aſſiduity to the ſtudy of the heavens, we ſhall in time obtain ſome faint knowledge of, and perhaps be able partly to delineate, *the Interior Conſtruction of the Univerſe.*

Datchet near Windſor,
April, 1784.

WILLIAM HERSCHEL.

Fig. 1

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Fig. 16

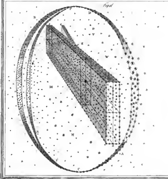

Fig. 17

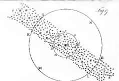

Fig. 18